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Strategies for Training Reservists With a Hand-Held Tutor

Theodore M. Shlechter

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Technical Director

JON W. BLADES
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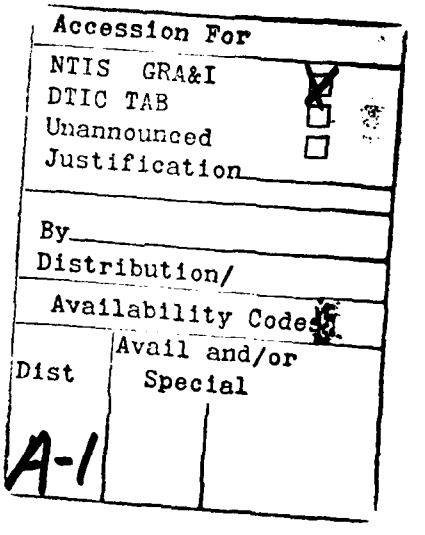
Technical review by

Joan Harman
Ronald E. Kraemer



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The purpose of this research was to (a) assess the effectiveness of the Hand-Held Tutor (HHT) for training fire commands to Reserve Component (RC) units; (b) compare the relative instructional effectiveness of small group and individualized presentation of the HHT materials; and (c) examine the importance of discussion of the instructional materials. Eighty-five soldiers from various RC units in Kentucky participated in the experiment. The experimental design was a 2 X 4 factorial for repeated measures. The factors were two levels of testing (pretest and posttest), which were repeated for all soldiers, and four different training conditions ("GRP," "DISC," "NON-DISC," and "IND"). The soldiers' mean scores on the performance and confidence measures increased from the pretest to the posttest assessments. The GRP training soldiers took less time to complete the instructional materials and made more correct responses to the embedded pretest items than did the soldiers in the other training conditions. This experiment's findings suggested that the HHT instructional program M1 Degraded Mode Gunnery and Multiple Return Strategies, should be implemented at RC units.

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Research Report 1547

Strategies for Training Reservists With a Hand-Held Tutor

Theodore M. Shlechter

Field Unit at Fort Knox, Kentucky
Donald F. Haggard, Chief

Training Research Laboratory
Jack H. Hiller, Director

U.S. Army Research Institute for the Behavioral and Social Sciences
5001 Eisenhower Avenue, Alexandria, Virginia 22333-5600

Office, Deputy Chief of Staff for Personnel
Department of the Army

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Training Simulation

FOREWORD

The modern Army must provide quality training to Reserve Component (RC) units while using fewer instructional resources. This research effort examined: (a) the instructional effectiveness of the Hand-Held Tutor (HHT), (b) the relative instructional effectiveness of small group and individualized presentation of the HHT materials, and (c) the importance of having soldiers discuss the HHT instructional materials.

This research was part of the Army Research Institute Fort Knox Field Unit's research program to apply new training technologies to meet armor skill training needs. A memorandum of agreement covering the application of training technology to armor skill training was signed by the U.S. Army Armor School (USAARMS), the U.S. Army Training and Doctrine Command (TRADOC), and the U.S. Army Research Institute for the Behavioral and Social Sciences (ARI) on 28 March 1987. The recommendations cited in this report were briefed to the training officers of the participating RC components during completion of this study. These training officers have requested to use the HHT for future training needs.

EDGAR M. JOHNSON
Technical Director

STRATEGIES FOR TRAINING RESERVISTS WITH A HAND-HELD TUTOR

EXECUTIVE SUMMARY

Requirement:

Two major instructional challenges to the Army are to (a) provide effective training while using few instructional resources; and (b) provide quality training to Reserve Component (RC) units. RC units have the same training requirements as do active component (AC) units; however, their training must be accomplished in approximately 20 percent of the time allocated to AC units and with far fewer instructional resources. To meet these instructional challenges, the U.S. Army Research Institute for the Behavioral and Social Sciences (ARI) has been developing a number of realistic and relatively inexpensive training approaches. ARI, for example, has developed a low-cost portable hand-held computerized tutor (HHT) for teaching fire commands. ARI has also found that small group presentation (four at a terminal) of computer-based materials would make the instructional program more cost efficient (Shlechter, 1987; 1988). Questions remain, however, about the underlying reasons for the instructional effectiveness of small group computer-based training. The purpose of this research was to (a) assess the instructional effectiveness of the HHT, (b) compare the relative instructional effectiveness of small group versus individualized presentation of the HHT materials, and (c) examine the importance of having soldiers discuss the instructional materials.

Procedure:

Eighty-five soldiers from various RC units in Kentucky participated in this experiment. These soldiers completed the HHT instructional booklet, M1 Degraded Mode Gunnery and Multiple Return Strategies. They also completed (a) a paper-and-pencil pretest and posttest, (b) pretests embedded in the HHT material, and (c) pre- and post-measures of the soldiers' confidence in their knowledge of M1 degraded mode gunnery and multiple return strategies.

The experimental design was a 2 X 4 factorial for repeated measures. The factors were two levels of testing (pretest and posttest), which were the repeated measures for all soldiers, and four different training conditions ("Grp," "Disc," "Non-Disc," and "Ind"). The Grp condition consisted of three soldiers per HHT terminal. The Disc training condition involved two soldiers per terminal discussing the instructional materials. For the

Non-Disc training condition, the two soldiers at each terminal were told not to discuss the instructional materials. The Ind condition consisted of one soldier per terminal.

Findings:

Analyses indicated a significant main effect for the soldiers' test scores on the paper-and-pencil instruments and their confidence scores as a function of the HHT training. The soldiers' mean scores for both of these dependent variables increased from the pretest measures to the posttest measures.

Significant effects were also found for the soldiers' time data and HHT embedded pretest data as a function of training conditions. The Grp trained soldiers took less time to complete the instructional materials than did the soldiers in the Disc and Ind conditions. The Grp soldiers also completed the courseware faster than did the Non-Disc soldiers; however, this difference was not statistically significant ($p = .09$). The Grp training soldiers also made significantly more correct responses to the embedded pretest items than did the soldiers in the other training conditions.

Utilization of Findings:

These findings suggest that the HHT instructional program, M1 Degraded Mode Gunnery and Multiple Return Strategies, can be implemented at RC units. The data also provide support for small group presentation of this material. The training officers for these RC units have requested to use the HHT for future training needs.

STRATEGIES FOR TRAINING RESERVISTS WITH A HAND-HELD TUTOR

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Introduction

A major instructional challenge to the modern Army is to provide more effective training while using fewer instructional resources. Hands-on training for teaching complex tasks such as issuing fire commands has been extremely expensive and very limited in terms of the total time available for training. For example, the cost of operating and maintaining a tank has been estimated to be nearly $280 per hour (Kristiansen, 1987).

Another major instructional challenge to the modern Army is to provide quality training to the reserve components (RC) units. It has been estimated that 52 percent of the Army is currently composed of RC units, who have the same training requirements as do active component (AC) units (Graham, 1987). However, the RC units must accomplish their training in approximately twenty percent of the time allocated to AC units (Graham, 1987). Graham has also noted that RC units are frequently short of training support materials and equipment. Very few RC units, for example, have access to a M1 tank, which makes it difficult to conduct hands-on training.

To meet these instructional challenges, the U.S. Army Research Institute (ARI) has developed a number of realistic and relatively inexpensive training devices. ARI has, for example, developed a portable hand-held computerized tutor (HHT) for teaching fire commands. While this instructional medium has been shown to be an effective device for training military vocabulary and mathematical skills to enlisted personnel (Fertner & Bridgeman, 1984; Harman, Bell & Laughy, 1989), its effectiveness for training M1 fire commands has not been determined.

ARI has also been investigating other training innovations which would help the Army to meet its instructional challenges, e.g., small group learning (Brooks et al., 1987; Hagman & Hayes, 1986; Shlechter, 1987; 1988). Shlechter (1988) found that small group (four at a terminal) presentation of computer-based materials would also help the Army to minimize instructional costs as such instruction is nearly five times more cost effective than is individual computer-based training (CBT). That is, soldiers who received small group CBT completed the computer lessons in less time and with the same achievement scores than the soldiers who received individual CBT. Small group CBT allowed more soldiers to receive training with a minimal need for computer equipment.

Many questions remain, however, about the issue of small group versus individual training. For one thing, questions remain about the tasks most suitable for small group learning.

The previously cited research by ARI dealt with using small group learning for teaching procedural tasks (Brooks et al., 1987; Hagman & Hayes, 1986; Shlechter, 1987; 1988). Shlechter's studies, for example, have examined small group CBT for teaching the different procedures associated with sending and receiving coded military messages. The civilian research literature has focused on examining group learning for either gaming or problem-solving tasks (e.g., Johnson, Johnson, & Stanne, 1986; King, 1988; Webb, 1988). King, for instance, examined the interactions within a small learning group for a task dealing with reproducing a complex computer design.

However, the relative instructional efficiency of using small group learning for teaching declarative knowledge tasks (i.e., the concepts behind the procedures) has not been established. Questions thus remain about using small group learning with the HHT materials as this instructional system was designed for teaching the concepts associated with issuing fire commands. After completing the HHT package, soldiers should be able to: (a) identify the different enemy targets; (b) identify the targets to engage first; (c) know the appropriate weapon and/or ammunition for the different targets; and (d) know the appropriate initial and subsequent commands required to engage and defeat the threat. The relative instructional efficiency of small group versus individualized presentation of the HHT subject materials would contribute to the body of knowledge concerning computer-based training.

Questions also remain about the underlying reasons for the previously cited instructional efficiency of small group CBT. Several researchers (Johnson & Johnson, 1986; King, 1988; Schoenfield, 1988; Webb, 1988) suggested that peer interaction was the key variable for the instructional effectiveness of small group CBT. As noted by Johnson and Johnson:

> "Within cooperative learning situations, on the other hand, students are required to discuss the materials being taught with one another, and there is considerable evidence that such discussions result in higher levels of cognitive reasoning, achievement..." (p. 12).

Webb (1988), for example, showed that elaborating upon the instructional materials had a positive effect upon the group's learning. Webb and the other researchers, however, have not directly compared small learning groups which discussed the instructional materials with those which did not. It could be that the verbal messages (e.g., elaborating upon the materials) are related to underlying non-verbal messages (e.g., giving support to other group members). These underlying non-verbal messages might be the key variables for the instructional effectiveness of small group instruction.

Purpose of the Research

The purpose of the research was to:

1. Assess the instructional effectiveness of the HHT for training fire commands.

2. Compare the relative instructional effectiveness of small group versus individualized presentation of the HHT materials.

3. Examine the importance of having soldiers discuss the instructional materials.

Method

Participants

Pilot Research. Forty-two soldiers participated in two pilot research efforts. Twelve of these soldiers participated in the initial pilot study which examined possible content problems with the courseware and the question of the maximum number of soldiers who could simultaneously use a hand-held terminal. These soldiers were from the new equipment training (NET) team at Fort Knox. The mission of this NET team was to train M60 tankers at different AC installations to use the M1 Tank. Thirty soldiers participated in a second research effort which examined possible problems with using the courseware and test items to train RC units. These soldiers were from the Headquarters Company of the 2/100 Armor Regt located in Lexington, KY.

Formal Research. Eighty-five RC soldiers with the 19K Military Occupational Specialty (MOS) for M1 Tank Commanders participated in the formal research. Sixty-one of these soldiers came from the 2/400th Armor Regt located in several small communities in eastern Kentucky. The remaining 24 soldiers came from the 2/100th Armor Regt based in Louisville, KY.

The ranks of the soldiers, who participated in the formal study ranged from private to sergeant major, with most participants having the rank of sergeant or higher. Their self-reported years of experience in the service, including years in AC and RC units, ranged from less than a year to more than 22 years. Their median level of experience was seven years. The range of self-reported years in the 19K MOS was between 0 and 17 years with a median level of three years in the 19K MOS. Finally, a vast majority of the soldiers reported that they had either taken some college courses or had graduated from college. (See Table 1 for a more detailed picture of the background of these soldiers.)

Table 1

Background Characteristics of Soldiers by Training Conditions

	Training Conditions			
	Ind (n=23)	Non-Disc (n=22)	Disc (n=19)	Grp (n=21)
Military Rank				
SFC	4	7	4	4
SSG	7	6	6	4
SGT	5	2	5	4
CPL	3	3	2	5
PFC	3	2	2	1
PVT	1	1	0	3
Yrs of Military Exp				
Range	0-17	1-18	1-17	0-21
Median	7	8.5	7	6
Yrs in PMOS				
Range	0-8	0-11	0-17	0-6
Median	1	3	3	3
Highest Level of Education				
GED	1	3	2	1
High School	8	5	3	9
Some College	9	7	7	7
College Grad	3	5	6	3
Other	2	2	1	1

Design

The experimental design was a 2 X 4 factorial for repeated measures. The factors were two levels of testing (pretest and posttest), which were the repeated measures for all soldiers, and

four different training conditions ("Grp," "Disc," "Non-Disc," and "Ind"). The Grp condition consisted of three soldiers per HHT, who were instructed to discuss the instructional materials. The initial pilot study indicated that this was the maximum number of soldiers who could simultaneously use the HHT terminal. The Disc training condition involved two soldiers per terminal who were instructed to discuss the instructional materials. For the Non-Disc training condition, the two soldiers at each terminal were told not to discuss the instructional materials. The Ind condition consisted of one soldier per terminal.

Twenty-one soldiers were assigned to the Grp condition; 20 soldiers to the Disc condition; 22 soldiers to the Non-Disc condition; and 23 to the Ind condition. One soldier in the Disc condition, however, failed to complete the posttest which left 19 soldiers in this condition. Assignments to the different training conditions were based on the soldiers' pretest scores with the stipulation that each condition consisted of approximately the same number of soldiers with pretest scores of: over 70 percent correct (a passing score by Army criteria); 50 to 69 percent correct; and less than 50 percent correct (see Table 2). Each terminal group within the Grp, Disc, and Non-Disc conditions consisted of matching soldiers with higher pretest scores with those with lower pretest scores.

Table 2

Pretest Scores by Training Conditions

	Training Conditions			
	Ind (n=23)	Non-Disc (n=22)	Disc (n=19)	Grp (n=21)
Pretest Scores				
70% or Higher	4	4	2	4
50%-69%	9	9	14*	12
Less than 50%	8	7	5	7

*Several of these scores were either at 67% or 50%.

Hardware and Courseware

The HHT was a 10" X 11" X 2" device with an indentation to hold a 5" X 5" booklet containing instructions and instructional materials. Feedback from this device was presented on a 32-character liquid crystal display or through an integral electronically synthesized voice system. User inputs were provided by a keyboard containing numbers 0-9, letters A-E, and three operational keys--Say, Erase, and Go. The Say key activated the HHT's feedback mechanism; the Erase key was used to delete an erroneous input statement; the Go key was used when the student wanted to go to the next unit, instructional phase, or item. (See Fertner & Bridgeman, 1984 for a more complete description of the HHT).

Included in the fire commands courseware were lessons on: (a) M1 Degraded Mode Gunnery and (b) Multiple Return Strategies. The M1 Degraded Mode Gunnery lesson involved ten units and the Multiple Return Strategies lesson consisted of three units. These two lessons were contained in a booklet which was approximately 200 pages long. This booklet was updated to meet the most current Army doctrine on M1 degraded mode gunnery and multiple return strategies. (See Appendix A for a listing of the different units for these two lessons).

Each unit contained a pretest and an explanation section. Each pretest consisted of 6 to 10 multiple-choice items. If the soldiers got all the pretest items correct, they could then proceed to the next unit without having to complete the explanation section. The explanation section provided detailed information about the materials covered on the pretest. Eight to twelve multiple-choice items were also embedded in each explanation section. If the students missed more than two of these questions, they were then branched back to the beginning of the section.

Picture Battle and Word War games were also scattered throughout the different lessons. These two games allowed the soldier to practice the knowledge acquired during the lesson. Picture Battle permitted students to "practice" their responses to engagement scenarios while Word War gave students the opportunity to test their understanding of the different military terms and expressions. Unfortunately, the time allotted by the different RC companies for this experiment did not permit the soldiers to play these two games.

Instruments

A paper-and-pencil pretest and a similar posttest were developed for the HHT lessons. These two tests consisted of 30 items of which 8 were included in both tests. The items, 21 on M1 Degraded Mode Gunnery and 9 on Multiple Return Strategies,

were taken from the item pool developed by Educational Testing Service for this booklet (Bridgeman & Fertner, 1986) and had item difficulty values of .50 to .80 as determined by an item analysis conducted after the second pilot study. (These two tests are presented in Appendix B).

As previously indicated, a background questionnaire was designed to assess the soldiers' prior educational and relevant military experiences. The following issues were addressed on this questionnaire:

1. Current military rank.

2. Years in the Reserves and Active Duty.

3. Years in Primary MOS (PMOS).

4. Highest civilian educational level.

This background questionnaire also included 10 items which examined the soldiers' confidence in their knowledge of M1 degraded mode gunnery and of multiple return strategies. For these items, the soldiers rated their confidence on a 1-5 scale with 5 being excellent and 1 being bad. (See Appendix C for a copy of the background questionnaire).

Three additional instruments were developed. A debriefing questionnaire was developed in which the soldiers had the opportunity to make favorable and/or unfavorable comments about the instructional materials. This questionnaire also consisted of the same ten confidence items which were included in the background questionnaire (see Appendix D for a copy of the debriefing questionnaire). Observational sheets were also developed (see Appendix E) in which observers could record the following information for each terminal:

1. Soldier(s) responding to the HHT items.

2. Time starting and finishing a chapter.

3. Pretest items correctly answered.

4. Type of discussion occurring at the Disc terminals.

5. Number of times that the soldiers exhibited off-task behaviors.

Because of resource constraints, it was only possible to use observers of each training group for the 2/100th Armor Regt.

Another instrument was developed (see Appendix F) in which the soldiers from 2/400th Armor Regt could record the following information for each unit:

1. Subject(s) responding to the HHT items.

2. Soldier(s) who responded to the items on the computer.

3. Time starting and finishing the chapter.

4. Pretest items correctly answered.

Two experimenters also observed the different Armor Regts to ensure that the required procedures were followed.

Procedure

The soldiers in the formal research were first administered the background questionnaire and the pretest. They had 15 minutes to complete the background questionnaire and 30 minutes to complete the pretest. The soldiers individually completed these instruments and they had enough time to answer all questions.

After the soldiers were placed into the different training conditions, they were provided detailed instructions by the experimenter on how to use the hand-held tutors. The soldiers were also instructed to complete the instructional materials by either discussing or not discussing the instructional materials and by skipping the "Picture Battle" and "Word War" segments. Instructions were also provided to the soldiers in the individual training condition and from the 2/400th Armor Regt regarding the procedures for completing the recording instrument while trained observers recorded the information for the Disc and Non-Disc soldiers from the 2/100th Armor Regt.

A civilian ARI employee who was expert in both the HHT system and the instructional materials was available to help the soldiers. This help was only provided when requested by the soldiers.

Immediately after completing the HHT lessons, the soldiers individually completed the posttest and the debriefing questionnaires. They had 30 minutes to complete the posttest and 15 minutes to complete the debriefing questionnaire. All soldiers were able to complete these instruments in the allotted time.

Training Procedures for the Observers

Four observers were used in this investigation. They were trained in the following ways:

1. A detailed set of instructions was given to each observer.

2. The experimenter discussed these instructions with each observer.

3. Each observer went through mock experimental sessions.

These sessions were completed when all observers went through a mock session without making any mistakes. The importance of refraining from helping or interfering with the soldiers was also emphasized to these observers.

Criterion Measures

The main criterion measures for this experiment were:

1. Number of items correct on the paper-and-pencil pretest (Pretest Scores).

2. Number of items correct on the paper-and-pencil posttest (Posttest Scores).

3. Confidence scores before completing the HHT lessons.

4. Confidence scores after completing the HHT lessons.

5. Time in minutes to complete the HHT lessons.

6. Number of items correct per unit for the pretests embedded in the HHT lessons.

Data Analyses

Two X four repeated measures ANOVs were computed to analyze the data for soldiers' scores on the paper-and-pencil tests and the confidence measures. As previously stated, these analyses consisted of two levels of testing, the repeated factor, and the four training conditions. SPSS^X, subprogram MANOVA was used to compute these repeated measure ANOVAs.

One-way ANOVAs were computed to analyze the time data and the HHT embedded pretest scores. The independent variable for these analyses was training condition. SPSS^X, subprogram One-Way was used to compute these analyses.

When significant effects were found for training conditions, the Tukey-HSD procedure was computed to determine the location of the effect(s). The Tukey-HSD tests were computed by using the SPSS^X set of computer programs. The alpha-level for the different analyses was set at .05. The source tables for the different analyses are presented in Appendix G.

Results and Discussion

A significant main effect ($F(1,81) = 194.58$; $p < .05$) was found for the soldiers' scores on the paper-and-pencil tests as a function of the HHT training. As shown in Table 3, the soldiers' mean scores for this dependent variable increased by more than six points or 20 percent from the pretest measure to the posttest measure. The subjects' improved performance on the posttest does not seem to be a function of repeated testing as their scores only increased 16 percent--4.45 to 5.76--on those eight items that were on both tests.

Table 3

Soldiers' Mean Pretest and Postest Scores by Training Conditions

	Training Conditions				
	Ind (n=23)	Non-Disc (n=22)	Disc (n=19)	Grp (n=21)	Total** (n=85)
Pretest Scores	16.78 (4.06)*	16.15 (4.13)	16.71 (3.81)	15.62 (4.89)	16.33 (4.19)
Posttest Scores	22.70 (4.85)	21.40 (4.10)	23.33 (4.24)	22.52 (4.61)	22.50 (4.46)

* Standard deviations are in the parentheses.

**Difference between pretest and posttest scores is significant at the .05 level.

The HHT courseware thus seemed to be an effective instructional program for RC soldiers as significant amounts of learning occurred for almost all of these soldiers. This learning was also manifested by the fact that only 16 percent of these students passed the pretest while 73 percent of them passed the posttest (see Table 4).

The data analyses showed that this program also helped these students to feel significantly ($F(1.81) = 10.43$; $p < .05$) more confident about their knowledge of M1 degraded mode gunnery and multiple return strategies as an increase of over a half-a-point on a five point scale was found from the pretest measure to the posttest measure of confidence (see Table 5). As suggested by McCombs (1984),this increase in confidence should decrease the students' insecurities and fears about learning more about fire

commands. This increase in confidence should also help these RC soldiers to become more secure in their abilities to actually perform fire commands.

Table 4

Percentage of Students Passing the Pretest and Posttest by Training Conditions

	Training Conditions				
	Ind (n=23)	Non-Disc (n=22)	Disc (n=19)	Grp (n=21)	Total** (n=85)
Pretest	17%	20%	10%	19%	16%
Posttest	78%	65%	71%	76%	73%

Table 5

Soldiers' Mean Confidence Scores on the Pretest and Posttest Measures by Training Conditions

	Training Conditions				
	Ind (n=21)	Non-Disc (n=22)	Disc (n=19)	Grp (n=21)	Total** (n=85)
Pretest Measure	2.87 (.85)*	3.13 (.84)	2.46 (1.16)	2.83 (.87)	2.82 (.95)
Posttest Measure	3.34 (.93)	3.48 (.76)	3.24 (.80)	3.23 (.81)	3.32 (.82)

*Standard deviations are in the parentheses.

**Difference between pretest and posttest scores is significant at the .05 level.

The data also indicated that the students were favorably impressed with the HHT program. They made 85 favorable comments regarding this program as opposed to 52 negative comments. Furthermore, 25 of these students had only favorable comments to make while just two of them made only negative comments. Most of the favorable comments dealt with the instructional program. For

example, providing immediate feedback to the students and repeating the information were two highly cited positive attributes of the HHT program.

It must be noted that the students expressed some ambivalence about using the HHT hardware. Several of them claimed that using such equipment increased their motivation to learn while others complained about the voice synthesizer, the small terminal screen, and the fact that the terminals had a tendency to run out of power. If there were more electrical outlets at the RC buildings, this latter problem would have been minimized.

Significant effects were also found for the time ($F(3,80)=3.13$; $p < .05$) and HHT embedded pretest ($F(3,80)=4.93$; $p < .05$) data as a function of the soldiers' training condition. As shown in Table 6, the Grp trained soldiers completed the instructional materials in significantly less time than the soldiers in the Disc and Ind conditions did. The Grp soldiers also completed the courseware faster than the Non-Disc soldiers did; however, this difference was not quite statistically significant ($p=.09$). Significantly more correct responses to the embedded items were made by the Grp training soldiers than by the soldiers in any other group (see Table 6). The Grp trained soldiers thus had an easier time in completing the computer lessons than the soldiers in the other conditions.

Table 6

Soldiers' Mean Time (In Minutes) and HHT Embedded Pretest Scores by Training Conditions

	Ind (n=22)	Non-Disc (n=20)	Disc (n=19)	Grp (n=22)
Time Scores	127.86 (23.39)*	124.50 (19.08)	133.43 (22.46)	112.85** (18.96)
HHT Pretest Scores	3.09 (.70)	3.29 (.54)	3.38 (.39)	3.71*** (.45)

*Standard deviations are in the parentheses.

**Significantly ($p < .05$) different from the Disc and Ind training conditions.

***Significantly ($p < .05$) different from the other training conditions.

The different analyses, however, failed to find any significant interactions in the soldiers' test scores and confidence scores between the two independent variables. The differences in training conditions had little or no effect upon the soldiers' abilities to learn the material and feel more sure about their knowledge of this material. The training conditions data thus indicated that more students could more easily complete the computer lessons in the small group instructional mode without experiencing any detrimental effects on their learning. In other words, the small group presentation mode was the most efficient instructional mode.

There was some marginal support for the instructional importance of discussing the material. First of all, the observers noted that the Non-Disc soldiers exhibited 71 incidences of off-task behaviors (e.g., looking away or reading some other material while a response was being made) as compared to 22 incidences for the Disc soldiers. Also, the discussions in the DISC group consisted mainly of elaborating upon the instructional materials. Finally, as shown in Table 2, the Grp and Disc soldiers did exhibit more learning than did the Ind and Non-Disc soldiers. However, as previously stated, this effect was not statistically significant.

Summary and Recommendations

In summary, this experiment's main finding is the effectiveness of the HHT system. Significant amounts of learning occurred for these students as a function of this instructional system. The HHT program, M1 Degraded Mode Gunnery and Multiple Return Strategies, can thus be implemented at RC units. This training system will help these units to meet their instructional need by providing an effective and relatively inexpensive approach for teaching fire commands. Perhaps this system could be further developed to help RC units meet other instructional demands (e.g., teaching a course on military communications).

This experiment's results have also shown that having three soldiers at a HHT terminal is the most instructionally efficient of the four training methods. This finding is important for several reasons. For one thing, it provides further evidence for Shlechter's (1987; 1988) argument that small group presentation of CBT materials can help the Army to minimize instructional costs. Under this instructional mode, more soldiers can effectively receive the training provided by the CBT system without the need to buy an excessive amount of computer equipment. Group presentation of the HHT training program will also help the RC units to further minimize their instructional costs as their instructional needs can be met with minimal number of HHT terminals. Also, this experiment's results have demonstrated the efficiency of using this small group CBT to teach a complex declarative knowledge task. Small group CBT may

thus be a most efficient training method for a wide variety of tasks.

Unfortunately, this experiment does not provide any clear insights into the underlying reason(s) for the instructional efficiency of small group CBT. There is some support for the instructional importance of discussing the materials but this effect was not statistically significant. One reason for this lack of statistical significance is that the Non-Disc soldiers did discuss the instructional materials. The observers have noted thirty-four incidences of discussion occurring at the Non-Dosc terminals as compared to two hundred ninety-three incidences at the Disc terminal. Another possible reason for this lack of statistical significance is that the learning patterns for the Non-Disc soldiers may have been very inconsistent. That is, these soldiers may have had a high learning rate for those instructional materials in which they responded to the HHT terminal and a low learning rate for those materials in which they observed the other student. It was impossible to determine the viability of this hypothesis as the soldiers from the 2/100 Armor Regt neglected to indicate who were the responders and the observers in each situation.

The following recommendations are made from this report:

1. The HHT instructional program, M1 Degraded Mode Gunnery and Multiple Return Strategies, should be implemented at RC units.

2. Group presentation with three at a terminal seems to be the most instructionally efficient method for using the HHT.

3. The importance of having students discuss the HHT instructional materials should be more carefully examined in future research studies.

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APPENDIX A

List of Units for the M1 Degraded Mode Gunnery and Multiple Return Strategies Booklet

Unit	Subject
	Introduction
	Training
	Directions
	M1 Degraded Mode Gunnery
1.	Crosswind Sensor
2.	Cant Sensor
3.	Lead Angle Sensor
4.	Laser Rangefinder (LRF)
5.	Stabilization System
6.	Gunner's Primary Sight (GPS) (Day Channel)
7.	Gunner's Primary Sight (GPS) Day Reticle
8.	Thermal Imaging System (TIS)
9.	Image Control Unit (ICU)/Electronic Unit (EU)
10.	Turret Power
	Multiple Returns Strategies
11.	Laser Rangefinder Information, GPS/TIS Symbology, and Range Returns
12.	Laser Rangefinder Switch Positions
13.	Multiple Return Strategies
	Word War
	Word War Contents

APPENDIX B

Paper-and-Pencil Pretest and Posttest for the M1 Degraded Mode Gunnery and Multiple Return Strategies Booklet

ID NUMBER_____ DATE_____

HANDHELD TUTOR - PRETEST
(Degraded/Multiple)

DIRECTIONS: For each question cross out the correct letter choice.

1) What is the function of the crosswind sensor?

A) Determine crosswind speed at target
B) Determine crosswind speed and direction at vehicle
C) Determine the tilt of the tank
D) Determine target speed

2) If the computer self-test indicates a cross wind sensor failure, what is the first thing you should do?

A) Report CROSSWIND SENSOR is OUT
B) Keep palm switches depressed
C) Respond to TC's fire command
D) Cancel CROSSWIND using CCP.

3) What is the function of the cant sensor?

A) Determine the windspeed at end of gun tube
B) Determine the lead for manual tracking
C) Determine the distance to a target
D) Determine the degree of cant when the gun trunnions are not horizontal

4) The function of the lead system is to:

A) Determine the range to a moving target
B) Determine the tilt of the tank
C) Determine the movement speed of the turret
D) Determine angle of the gun tube elevation

5) What is the suggested standard lead when firing HEAT ammunition at a moving target?

A) 2-1/2 mils
B) 5 mils
C) 7-1/2 mils
D) 10 mils

6) How should you engage a moving target with SABOT, once it has been determined that the lead angle sensor has failed?

A) Fire using the GAS and SABOT ammunition
B) Fire using the GPS without any correction for lead
C) Fire using the GAS without any correction for lead
D) Fire using the GPS and the suggested standard lead

7) One check you should make when an "F" appears in the GPS is:

A) Laser RANGE switch is in ARM 1ST RTN or ARM LAST RTN
B) THERMAL MODE switch is in STBY
C) Daylight ballistic door is open
D) GPS (day channel) is ON

8) When an "F" appears in the GPS, it indicates a:

A) Possible cant sensor failure
B) Possible LRF failure
C) Possible lead system failure
D) All of the above

9) Which is <u>not</u> an indication of a stabilization system failure?

A) View in GPS/TIS jumps around
B) Unable to keep reticle on target
C) Flashing "0000" appears in the GPS
D) Erratic gun/turret movement

10) In what position should you place the FIRE CONTROL MODE switch when the stabilization system fails?

A) EMERGENCY
B) SAFE
C) MANUAL
D) NORMAL

11) An indication of possible failure to the GPS (day channel) would be:

A) Circuit breaker are ON
B) Flashing "0000" appears in the GPS
C) Obstructed view of outside area, in 3x or 10x magnification
D) "F" appears in the GPS

12) What is the function of the GPS (day channel)?

A) Provide daylight optics for target acquisition, identification, and engagement
B) Provide target inteneration during daylight
C) Provide for stabilized operation in NORMAL mode
D) Provide solutions for fire control fault indications

13) Which of the following indicates a possible GPS day reticle failure?

A) Loss of symbology.
B) Range data in GPS do not change after lasing.
C) Obstructed view of outside area in 3X or 10X magnification.
●) Reticle is not seen in the GPS.

14) Which of the following checks should you make to correct a possible GPS day reticle failure?

A) FIRE CONTROL mode switch is in NORMAL
●) GPS reticle control is fully clockwise
C) NO GO lamp is not illuminated
D) Laser RANGE switch is in ARM LAST RTN

15) What is the function of the TIS?

A) Provide sight stabilization at night
B) Provide an aiming point for night engagements
●) Provide optics for target acquisition, Identification, and engagement during daylight or at night

16) If the TIS fails during a nighttime engagement, the TC could switch to:

A) The GPS, provided there is sufficient light (moonlight) to see the target
B) The GAS, provided there is sufficient light (moonlight) to see the target
●) Either A or B

17) Which of the following symbols is not provided by the ICU/EU?

●) Ready-to-fire
B) PASS
C) BAR
D) Fire control fault

18) When firing the main gun, which sight should you use if the ICU/EU fails?

●) GPS (day channel)
B) TIS
C) GAS
D) Infinity

19) Turret power enables you or the TC to:

A) Traverse the turret
B) Elevate or depress the main gun
C) Elevate or depress the coax
●) All of the above

20) If a turret power malfunction cannot be corrected, you should switch FIRE CONTROL MODE to:

A) MANUAL
B) NORMAL
C) EMERGENCY
D) ON

21) The multiple return symbol will appear in the GPS/TIS only when:

A) The "F" symbol appears in the display
B) The LRF receives more than one return
C) Both A & B
D) "MULTIPLE RETURN" appears in the display

22) The accuracy of the laser rangefinder is plus or minus:

A) 5 meters
B) 10 meters
C) 20 meters
D) 50 meters

23) What symbol is used to indicate a multiple return?

A) A bar below the range display
B) An "F" symbol
C) A bar above the range display
D) Bars above and below the range display

24) Which of the following objects can reflect, absorb, or scatter the laser beam?

A) Strong wind
B) Bright sunshine
C) Fog or smoke
D) Clear sky

25) In which position should the laser RANGE switch be set when there is smoke or trees between you and the target?

A) SAFE
B) ARM LAST RTN
C) ARM 1ST RTN

26) The main concern for switching the LRF to SAFE is:

A) To prevent serious eye damage by accidental firing
B) To conserve battery power
C) To recharge the laser
D) Both B and C

27) What range will be displayed in the GPS/TIS when lasing to a target in the ARM 1ST RTN postion?

A) First range sensed by the LRF receiver
B) Last range sensed by the LRF receiver
C) Battle ranges manually indexed into fire control system
D) Both first and last range return

28) If the second range displayed/announced is still not correct, the TC should:

A) Override the gunner, lay, lase, and fire
B) Command "RELASE"
C) Depress MANUAL RANGE BATTLE SGT button
D) Command "Fire and Adjust"

29) If the TC decides to correct the range displayed in the GPS/TIS, he could:

A) Depress MANUAL RANGE BATTLE SGT button
B) Use the MANUAL ADD/DROP SWITCH
C) Either A or B
D) Use the GPS (E)

30) How close or accurate should the displayed range be to the estimated range before announcing ON THE WAY?

A) 100 meters
B) 200 meters
C) 300 meters
D) 400 meters

ID NUMBER:_____ DATE:_____

HANDHELD TUTOR - POSTTEST
(Degraded/Multiple)

DIRECTIONS: For each question cross out the correct letter choice

1) What is the function of the crosswind sensor?

A) Determine crosswind speed at target
B) Determine crosswind speed and direction at vehicle
C) Determine the tilt of the tank
D) Determine target speed

2) Which of the following numbers indicates a crosswind sensor failure during a computer self-test?

A) "2"
B) "3"
C) "4"
D) "5"

3) What is one indication of a known cant sensor failure?

A) Computer shows CANT FAILED AT WINDOW
B) "2" appears in CCP display
C) An "F" symbol appears in GPS
D) "3" appears in CCP display

4) When applying a cant correction, you should aim:

A) 1 mil higher for each 1000 meters
B) 1 mil higher for each 1000 meters and in the opposite direction of cant
C) 1 mil higher for each 1000 meters and in the same direction of cant
D) 1 mil lower for each 1000 meters

5) What is the cant correction when firing at a target at 2000 meters from a stationary tank?

A) None
B) 1 mil higher and in opposite direction of cant
C) 2 mils higher and in opposite direction of cant
D) 3 mils higher and in opposite direction of cant

6) If the lead system fails during a computer self-test, you should immediately:

A) Check circuit breakers are on
B) Report lead system is out
C) Respond to TC's fire command
D) Check the Laser Range switch

7) The function of the lead system is to:

A) Determine the range to a moving target
B) Determine the tilt of the tank
C) Determine the movement speed of the turret
D) Determine angle of the gun tube elevation

8) The function of the laser rangefinder is to:

A) Determine battlesight range
B) Determine the range from tank to target
C) Determine the lead required to engage target
D) Determine the amount of vehicle cant

9) One check you should make when an "F" appears in the GPS is:

A) Laser RANGE switch is in ARM IST RTN or ARM LAST RTN
B) THERMAL MODE switch is in STBY
C) Daylight ballistic door is open
D) GPS (day channel) is ON

10) What is one indication of a known stabilization system failure?

A) Flashing "0000" appears in the GPS
B) "F" appears in the GPS
C) Unable to keep reticle on target
D) "8" appears in the CCP display

11) Which is <u>not</u> an indication of a stabilization system failure?

A) View in GPS/TIS jumps around
B) Unable to keep reticle on target
C) Flashing "0000" appears in the GPS
D) Erratic gun/turret movement

12) An indication of possible failure to the GPS (day channel) would be:

A) Circuit breakers are ON
B) Flashing "0000" appears in the GPS
C) Obstructed view of outside area, in 3x or 10x magnification
D) "F" appears in the GPS

13) The function of the GPS day reticle is to:

A) Provide an estimated range to distant targets
B) Provide sight stabilization during vehicle movement
C) Provide an aiming reference for target engagement
D) Provide range data for a ballistic solution

14) Which of the following indicates a possible GPS day reticle failure?

A) Loss of symbology
B) Range data in GPS do not change after lasing
C) Obstructed view of outside area in 3X or 10X magnification
D) Reticle is not seen in the GPS

15) What is the function of the TIS?

A) Provide sight stabilization at night
B) Provide an aiming point for night engagements
C) Provide optics for target acquisition, Indentification, and engagement during daylight or at night

16) Which of the following would cause the gunner <u>not</u> to acquire a target through TIS?

A) FLTR/CLEAR/SHTR switch in Clear
B) Thermal ballistic door open
C) Unit TEST PATTERN switch OF
D) Daylight ballistic door OPEN

17) The ICU/EU provides the thermal sight reticle and symbols displayed in the:

A) GPS day channel sight
B) TIS sight
C) GAS
D) Both A and B

18) What is the function of the ICU/EU?

A) Provide a stabilized platform
B) Provide TIS reticle and GPS/TIS symbols
C) Provide ballistic solution
D) Provide the GPS day reticle

19) Turret power enables you or the TC to:

A) Traverse the turret
B) Elevate or depress the main gun
C) Elevate or depress the coax
D) All of the above

20) What is one indication of a turret power failure?

A) Turret power lights on TC's control panel are lit
B) Power control handles are inoperative
C) Turret traverse lock is UNLOCKED
D) "F" appears in the GPS

21) The multiple return symbol will appear in the GPS/TIS only when:

A) The "F" symbol appears in the display
B) The LRF receives more than one return
C) Both A and B
D) "MULTIPLE RETURN" appears in the display

22) How many types of symbols are displayed in the GPS(E)?

A) one
B) two
C) three
D) four

23) The accuracy of the laser rangefinder is plus or minus:

A) 5 meters
B) 10 meters
C) 20 meters
D) 50 meters

24) The LRF can determine range to targets from:

A) 200-2000 meters
B) 290-3000 meters
C) 300-6000 meters
D) 200-7990 meters

25) What symbol will appear above the RANGE display if the laser beam "spills over" the target?

A) Ready-to-fire
B) "F" symbol
C) Multiple return bar
D) Range symbols

26) In which of the following positions should the laser RANGE switch be set for most battlefield situations?

A) SAFE
B) ARM LAST RTN
C) ARM 1ST RTN
D) EMERGENCY

27) Which situation would require you to use the ARM 1ST RTN position?

A) There is dust blowing across the battlefield
B) There are bushes between you and the target
C) The target is extremely small
D) All of the above

28) If the TC decides to correct the range displayed in the GPS/TIS, he could:

A) Depress MANUAL RANGE BATTLE SGT button
B) Use the MANUAL ADD/DROP SWITCH
C) Either A or B
D) Use the GPS(E)

29) If the displayed range is <u>within</u> 200 meters of the estimated range, your next action will be:

A) Announce ON THE WAY and fire
B) Relase
C) FIRE
d) Switch LRF to ARM LAST RTN

30) What action must you take after deciding that the range displayed is more than 400 meters off the initial estimate of the target range?

A) Announce ON THE WAY and fire
B) FIRE
C) Relase to target
D) Depress MANUAL RANGE BATTLE SGT button

APPENDIX C

Background Questionnaire

FOR RESEARCH USE ONLY

U.S. Army Research Institute

Fort Knox Field Unit

HAND HELD TUTOR QUESTIONNAIRE

DATA REQUIRED BY THE PRIVACY ACT OF 1974

AUTHORITY: Title 10, USC, Sec 4503

PRINCIPAL PURPOSE: The data collected with this form are to be used for research purposes only.

ROUTINE USE: This is an experimental personnel data collection form developed by the U.S. Army Research Institute for the Behavioral and Social Sciences pursuant to its research mission as prescribed in AR 70-1. When name or social security number are requested they are to be used for administrative and statistical control purposes only. Full confidentiality of the responses will be maintained in the processing of these data.

DISCLOSURE: Your participation in this research is strictly voluntary. Individuals are encouraged in the interests of the research, but there will be no effect on individuals for not providing all or any part of the information.

The purpose of this questionnaire is to collect background information on soldiers who participate in our studies. This information is for research purposes only and will not affect your standing in your job or course work. Complete each question, Write "NA" for each question that you cannot answer.

1. Name:_____ Unit_____

2. Social Security Number:_____

3. Pay Rank: _____

4. Are you active duty or U.S. Army Reserve: _____

5. Number of years in U.S. Army Reserve:_____

6. Number of years in active duty:_____

7. Primary PMOS:_____ Number of years in PMOS:_____

FOR RESEARCH USE ONLY

SSN_____

FOR RESEARCH USE ONLY

8. Have you been reclassified into this PMOS? Yes_____ No_____

   If "Yes" - What was your previous PMOS?_____

   When were you reclassified?_____

9. Number of years (or months) as a member of a M1 tank crew:_____

10. Number of years (or months) as a member of a M60 tank crew:_____

11. Number of years (or months) as a member of a Bradley tank crew:_____

12. Number of years (or months) as a member of any other track vehicle crew:_____; type of vehicle

13. Are you now or have you been a TC? Yes_____ No_____

    If "Yes" --List the type(s) of track vehicle (s) with the corresponding number of years (or months) as TC:

    _____

    _____

14. Total number of years (or months) as a gunner and/or loader:_____

15. Have you completed the Primary Leadership Development Course (PLDC)? Yes_____ No_____

    If yes, list dates for attending the course_____

16. Have you completed any courses of advanced training with tracked vehicles (e.g., BNCOC; ANCOC; AOB; AOCAC:)

    If yes, indicate the particular courses and the dates attending the course:

    Course_____ Date_____

    Course_____ Date_____

    Course_____ Date_____

    Course_____ Date_____

FOR RESEARCH USE ONLY

SSN_____

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17. Highest civilian educational level completed. (check one)

GED_____

High School graduate_____

Some college_____

College graduate_____

Other (please state)_____

18. On a scale with 5 = Excellent, 4 = good, 3 = adequate, 2 = poor, and 1 = bad, rate your knowledge of the following:

a. Crosswind Sensor:_____

b. Cant Sensor:_____

c. Lead System:_____

d. Laser Range Finger:_____

e. Stabilization System:_____

f. Gunner Primary Sight:_____

g. Thermal Imaging Systems:_____

h. Image Control Unit:_____

i. Turret Power:_____

j. Elements of Fire Command:_____

k. Classes of Targets:_____

l. Types of Fire Command:_____

FOR RESEARCH USE ONLY

SSN_____

FOR RESEARCH USE ONLY

m. Crew Responses:_____

n. Ammo/Weapon Choices:_____

o. Procedures for Correcting Fire Commands:_____

p. Techniques of Direct Fire:_____

q. Multiple Return Strategy (1):____

FOR RESEARCH USE ONLY

APPENDIX D

Debriefing Questionnaire

FOR RESEARCH USE ONLY

Subject No_____ Date_____

1. What did you like about the instructional materials?

2. What did you not like about the instructional materials?

3. What did you like about the method of presenting the instructional materials?

4. What did you not like about the method of presenting the instructional materials?

5. On a scale with 5 = excellent; 4 = very good; 3 = adequate: 2 = poor; and 1 = bad, rate your knowledge of the following:

a. Crosswind Sensor:_____

b. Cant Sensor:_____

c. Lead System:_____

d. Laser Range Finder:_____

e. Stabilization System:_____

f. Gunner Primary Sight:_____

g. Thermal Imaging System:_____

h. Image Control Unit:_____

i. Turret Power:_____

j. Multiple Return Strategies (M1):____

Appendix E

A Sample of the Recording Sheets Used by the Observers

FOR RESEARCH ONLY

SUBJECTS_____

LESSON_____

TIME: FROM_____ TO_____

BREAK TIME: FROM_____ TO_____

NUMBER CORRECT FOR PRETEST _____

ITEMS	WHO MADE RESPONSE	WRONG RESP.	WHO NEEDED HELP	WHO GAVE HELP	TYPE OF DISC.	OFF TASK

Appendix F

A Sample of the Recording Sheets Used by the Soldiers

FOR RESEARCH USE ONLY

SUBJECTS: _____

LESSON _____

UNIT _____ TIME: FROM _____ TO _____

BREAK TIME: FROM _____ TO _____

Number correct for Pretest _____

COMMENTS:

UNIT _____ TIME: FROM _____ TO _____

BREAK TIME: FROM _____ TO _____

Number correct for Pretest _____

COMMENTS:

UNIT _____ TIME: FROM _____ TO _____

BREAK TIME: FROM _____ TO _____

Number correct for Pretest _____

COMMENTS:

Appendix G

Table 1

Source Table for the Different Analyses

Paper-and-Pencil Test Data Source	SS	DF	MS	F	Sign
Between-Subjects Effect					
Within Cells	241.11	81	29.77		
Training Conditions	41.74	3	13.91	.47	.706
Within-Subject Effect					
Within Cells	672.17	81	8.30		
Testing Factor	1614.70	1	1614.70	194.58	.000
Training Conditions By Testing Factor	17.01	3	5.67	.68	.565

Appendix G

Table 2

Source Table for the Different Analyses

Confidence Data	SS	DF	MS	F	Sign
Between-Subjects Effect					
Within Cells	95.61	81	1.18		
Training Conditions	41.74	3	1.44	1.22	.307
Within-Subject Effect					
Within Cells	30.79	81	.38		
Testing Factor	10.43	1	10.43	27.44	.000
Training Conditions By Testing Factor	1.13	3	.38	.99	.401

Appendix G

Table 3

Source Table for the Different Analyses

Time Data Source	SS	DF	MS	F	Sig Level
Between Groups	4766.25	3	1588.75	3.13	.03
Error	40663.31	80	508.29		
Embedded Pretest Data					
Between Groups	4.32	3	1.44	4.93	.03
Error	23.39	80	.29		